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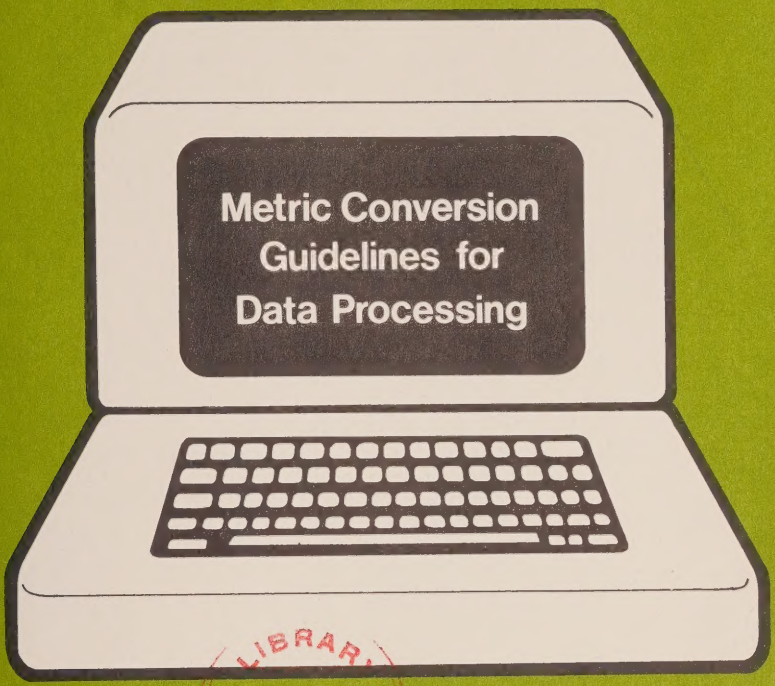
Metric Conversion Guidelines for Data Processing



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Preface

In 1970 the Canadian Government, in the *White Paper on Metric Conversion in Canada*, proposing the adoption of the most up-to-date system of measurement, the International System of Units or SI. Simplicity and universality are the benefits of adopting SI.

Since the establishment of Metric Commission Canada in 1971, many individuals in all types of organizations, provincial and federal governments and all sectors of the economy have been working to convert their operations efficiently to SI with minimum disruption. The Canadian economy at present is committed to SI.

For those who are not convinced about metric conversion, it may be appropriate to say that 99% of all countries in the world use metric units. If the input data and required outputs are in metric, the internal processing and internal reporting in non-metric terms can cause confusion and additional expenditure. Similarly, it would be clear upon analysis that if the metric conversion is planned realistically, executed logistically with effective monitoring and feedback, the conversion can only be to the advantage of the organization.

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Metric Conversion Guidelines for Data Processing

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Introduction

This brochure was prepared in order to assist data processing managers in understanding the impact of metric conversion in the Data Processing Environment.

Since data processing is one of the areas where metric conversion can have significant effect, data processing professionals must be prepared to change the systems which will be affected with the introduction of metric in their company. Data processing professionals with their expertise and knowledge of number systems will find the International System of Units (SI) rational, consistent and straightforward. However, they might find that for converting data processing systems, the technical aspects of the metric system are not necessarily as significant as are the general considerations.

This brochure is designed to help those who are either planning for or in the process of conversion. It covers both the technical data processing considerations and the general aspects of metric conversion such as the planning, scheduling, logistics and management. The general design permits all companies, small, medium or large, to scale it to their individual requirements.

The basic responsibility of the conversion lies with corporate management and they must decide how and when the conversion should be done. Metric Commission Canada helps all sectors to plan, publicize and co-ordinate their conversion plans.

The Conversion Decision

The subject of metric conversion in the data processing (DP) department often comes as the result of an urgent request from corporate management asking 'What are we doing?' or 'Where do we stand?' with respect to metric conversion in data processing.

The responsibility for metric conversion should not fall upon the data processing function. To be successful, a metric conversion program requires a firm commitment and direction on the part of senior management. A metric conversion task force or coordinator should be appointed to spearhead the program and to integrate the activities of the various functions including data processing, both in planning and in execution.

It must be recognized that, in many situations, data processing is the point of convergence for measurement — sensitive data and applications which cut across organizational lines. In such situations, data processing will play a central and important role in the overall metric conversion plan. Moreover, in large organizations, the data processing department may provide a valuable service to the rest of the organization in planning and managing the total conversion process.

One or more contact persons should be designated within each functional area of the organization to participate in the metric conversion planning process. Aside from acting as the focal point for 'local' conversion activities within their own departments, these individuals will interact with each other to work out details which affect more than one organizational unit.

When making the above appointments, management should establish overall guidelines and priorities for the conversion plan. Policies with respect to timing of the conversion, costs and financing, exploitation of new opportunities which result from metric conversion, conformity with industry plans and plans of customers or suppliers, etc. should be set. The plan for metric conversion should specify where within the organization individual conversion decisions will be made. Systems and data processing must rely mainly on the operating functions which they serve to make decisions as to the nature and extent of individual conversions, to define metric specifications and standards, and to specify changes in their 'user' specifications for DP systems. At the same time, DP personnel may play a valuable role in these deliberations by pointing out opportunities for improvement, potential problems or other details of the conversion which might otherwise be overlooked. In particular, DP involvement can be critical in situations where different applications and departments must interact in a common system.

Organization and Investigation

It must be realized that metric conversion in data processing is an integral part of an organization's overall conversion program. As such, a great deal of its planning will need to be coordinated with the plans of the rest of the organization. Seen from the management viewpoint, the data processing function has two dimensions to its conversion, namely (i) that of an operating department whose operations must be modified (the 'line' dimension), and (ii) that of a resource or service department to assist other functions in their conversions (the 'staff' dimension).

This means that the data processing group will have a key role to play in metric conversion in many organizations, and emphasizes the necessity of maintaining close liaison with all other groups involved in the conversion activities. In the early stages of planning and conversion, the data processing group will rely heavily on other operating departments to make decisions re the nature and extent of individual conversions, to define metric specifications and standards, and to specify changes in their 'user requirements' for DP systems.

Our suggested organization for metric conversion within data processing takes account of these working relationships. Just as a conversion coordinator is needed at the company level, so a coordinator should be appointed for conversion operations within data processing. The coordinator's staff resources should be minimal, as he or she is not expected to perform any of the actual conversion work, but rather to plan, monitor, and coordinate the activities of the various application support personnel within the department, and to ensure their effective liaison with external groups.

A DP metric conversion committee may be formed under the chairmanship of the coordinator with a representative from each major application support team. It will generally be advisable to include representatives from the systems programming group to assist in file conversions and special setups, and from the data control/operations group to assist in procedural changes relating to input and output, parallel testing and validation. The relationship between the coordinator and the members of his committee is not one of line authority, but rather one of staff support, information gathering and dissemination, and progress monitoring. The existing authority structure within data processing is not disturbed. The coordinator still reports to data processing management, which in turn assign the actual conversion tasks as required. While the data processing conversion coordinator has a staff relationship to the company conversion coordinator, and may sit on an organization-wide metric conversion committee, it is the director of data processing who is ultimately responsible to senior management for the success of the conversion program within his department.

The Impact of Metric Conversion on Business Systems

The transition to the International System of Units (SI) may impact data processing systems in the following areas: use of character sets, definition of data field sizes, numeric precision and accuracy, logic and mathematical calculations, conversion of historical data, and positioning for computer-driven devices such as plotters and machine tools.

The degree of impact from metric conversion will vary depending upon the nature of the particular system. Some systems will not be affected at all or in such minor ways that they can readily accommodate the change. Other systems will have to be converted to accept and process both metric and non-metric data.

Consideration should be given to conducting an impact analysis on each system in operation or design. The analysis should consider the system inputs, processing and outputs and to what degree it is measurement-sensitive. Taken into consideration with the life cycle of a particular system, the results would identify the impact metric conversion has on a particular system. These results should be documented. Having appropriate forms or charts might assist with the documentation and review tasks. This analysis should be performed in close consultation with the 'users'.

Recommended steps in a system impact analysis are:

(a) Determine what measurement units are used in the system.

(b) Conduct a field-by-field analysis of range and accuracy requirements.

(c) Examine calculation routines for required changes to either logic or constants.

(d) Identify files and data elements involved.

(e) Discuss with the users any anticipated changes to their needs and the scheduling of this with the rest of the organizational changes, if any.

(f) Identify other related areas such as invoicing, purchasing, unit cost accounting and possible identification number changes.

(g) Determine if both imperial and metric units must be maintained and/or processed.

(h) Determine the life cycle of the system.

(i) Determine the most effective conversion method:

  (i) Preprocessors and postprocessors
  (ii) Dual capability
  (iii) One time conversion to metric

This is not a comprehensive checklist but will provide a starting point for the planning process.

Although the time and effort to carry out the impact analysis could be substantial, it is deemed worthwhile because it provides:

(a) a database for the timetable of work.

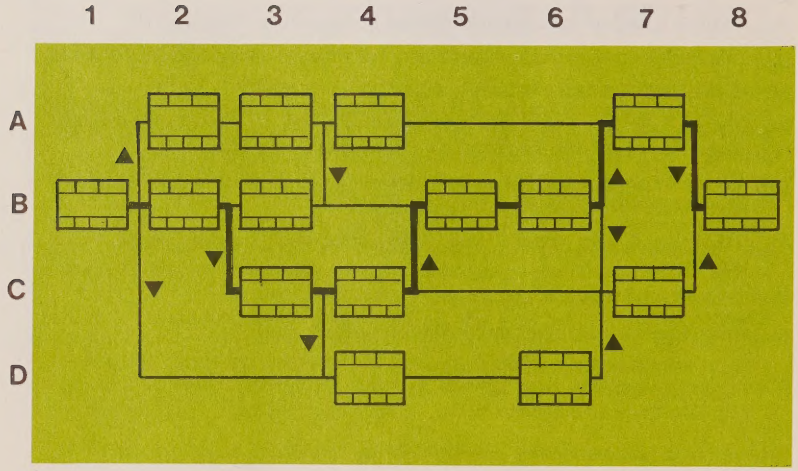
(b) the applications analyst, programmers and users the necessary review of the systems, their inter-relations and the magnitude of revisions.

(c) identification of potential problem areas.

(d) identification of areas where decisions concerning metric units, tolerances, preferred sizes and new standards are required.

(e) identification of areas where education on metric and its application within the company should be given to operational staff.

Having completed a survey of the systems and programs affected through the impact of analysis, it is now a matter of compiling a list to indicate those areas and functions within the organization which will be affected. Estimating the extent and nature of the effects both on the people and the systems will identify the magnitude of the conversion task, the education requirements of operational and conversion staff and the number of programs requiring modification.



Planning and Scheduling

After the decision has been made by management to proceed with conversion to SI, the first step, as described in the preceding section, is to investigate the nature and scope of the conversion requirements. In order that a useful conversion plan may be constructed, it is essential that there be a clear definition of the work to be performed and of the constraints within which the conversion must take place.

Once the objectives of the conversion program have been defined and agreed upon, it is then possible to proceed with the formulation of a strategic plan, which describes each of the tasks to be performed in the conversion process. It is generally useful to break down the conversion project into as many separately-definable tasks as can reasonably be managed.

For each task which has been identified, the conversion plan should specify at least the following information:

(a) the person or group responsible for managing the work

(b) the person or group responsible for doing the work

(c) the manpower resources required

(d) other tasks which must be completed before the specified task can proceed

(e) other tasks which cannot proceed until the specified task has been completed

(f) external events which must occur before the specified task can proceed

(g) external requirements which impose limitations on the flexibility permitted in the scheduling of the specified task

(h) target dates associated with clearly-definable objectives and key-events.

If the conversion job is a large one, with many interdependent tasks, one may find it beneficial to take advantage of one or more of the various computer-assisted scheduling techniques, such as precedence diagramming, a form of network planning similar to PERT (Project Evaluation and Review Techniques) or CPM (Critical Path Methods), which are available from computer manufacturers and other software suppliers. These scheduling packages simplify the job of creating a work-plan which takes into account the constraints within which the project must proceed (as will be described later in this section). Computer-assisted scheduling can also be used as a tool for monitoring progress relative to the planned schedule, for monitoring costs relative to budgets, for allocating staff resources, and for modifying the plan (again, taking into account the imposed constraints) in the event that any activities should fall behind schedule.

The actual mechanism used to define the conversion plan is a matter of choice. The important points are that a plan must be prepared, and that a commitment to make positive efforts towards the successful implementation of this plan must be obtained from all parties who will be concerned or affected in any way.

It is worth noting that all Metric Commission Canada sector plans have been developed using the precedence diagramming method and a computer-assisted scheduling system is being used to update and manage the implementation process.

Each DP manager should develop a metric conversion plan which is consistent with the company's Metric Conversion Plan. The lack of planning is the most frequently quoted reason for metric conversion difficulties.

Typical Conversion Tasks

The list of actual tasks to be performed will vary somewhat from one data processing application to another. However, in general, the SI conversion of data processing systems may be expected to involve most of the following steps or tasks, to be performed more-or-less in the sequence indicated, for each sub-system which can be identified.

(a) Redesign the input and output documents to incorporate SI units

(b) Redesign the formats and/or structures of data files

(c) Revise the operating procedures and user documentation, and train the users of the system

(d) Modify the computer programs and supporting documentation as required to operate in SI units

(e) Test and debug each individual software module as it is converted

(f) Test the interaction of the modules and verify that the complete converted system is functioning correctly

(g) Test the interactions of the converted system with all other systems with which it communicates or shares common data

(h) Convert data files to SI units as required. Conversion factors are available in the *Canadian Metric Practice Guide* — CAN3-Z234.1-79

(i) Begin inputting of current data in SI units

(j) Begin production use of the converted software

(k) Begin producing output reports in SI units.

External Constraints on Scheduling

In the planning and scheduling of data processing conversion, the DP manager will be required to take into account several factors which are beyond the control of the data processing department. The conversion of data processing applications will probably be required to fit into an overall conversion plan for all company activities. The company conversion schedule may, in turn, be dictated by the necessity to synchronize activities with the national sector plans, and with customers, suppliers and the public at large. In larger organizations this process may have to be harmonized with headquarters objectives and schedules.

Thus, it may be that input data for some systems must be obtained from external sources. In many cases, neither the data processing department nor the user will be able to influence the schedule under which the data source will be willing or able to provide input data in SI units.

Similarly, output reports may be directed towards external users who will be in a position to dictate the schedules under which revised output will be required or accepted. In some cases, the scheduling of conversion activities may be governed by regulatory or legal reporting requirements.

In some cases, the conversion of a system may require the design and production of pre-printed forms. The delivery times for the new forms could be substantial, and

should, in any case, be considered in the planning process.

The initial investigation stages and the planning stages require the active participation of the users of each system, since the users must verify that the conversion objectives are both appropriate and complete and that the conversion schedules conform to their needs. In addition, the conversion coordinator should participate in these stages in order to ensure that company schedules and standards will be met.

In the development and testing stages, the participation of the users may not be very extensive in terms of staff-hours. It is nevertheless essential that the users do play their parts as and when required. In order that the data processing conversion may proceed on schedule, both the users and the data processing staff must be fully committed to the schedule. This implies that the users must assign sufficient priority to their participation so that the conversion work will not be delayed in favour of other duties. The conversion coordinator should be able to assist in obtaining the required commitments from the user groups.

Internal Constraints on Scheduling

As already mentioned, the scheduling of data processing conversion must be in compliance with the overall conversion plan for the company as a whole. In the preparation of the plan, the limitations of the data processing department must be considered. It would be unrealistic to expect the data processing section to work within a conversion schedule which does not take into account the following factors:

(a) Systems may be interdependent in that the output of one system may be used as input to another.

(b) Common data files or data bases may be shared by several systems. The conversion of formats and units for data storage must be coordinated with the conversion of both the systems which cause data to be entered into the common files and also the systems which use data retrieved from the common files.

(c) The schedule must be consistent with the ability of the data processing section to commit staff resources to SI conversion.

If there is a substantial volume of conversion work to be done, then the management must recognize that either (a) additional staff must be obtained for the conversion period, or (b) other development activities (and, perhaps, maintenance activities as well) must be delayed, or (c) some of the conversion work may have to be done by outside contractors.

Futhermore, the overall schedule for data processing conversion should be planned in such a way as to avoid large peaks in the staff requirements. This may dictate that development work on some systems should proceed considerably earlier than the time when the users will be ready to implement the revised systems. In such cases, it may be necessary to solicit the participation of the users at a time when they do not yet regard conversion as a matter of any urgency, and it may be very important that the data processing section exercise some initiative in the preparation of schedules. As noted earlier, the authority of the conversion coordinator may be useful in securing the necessary cooperation from the users.

Factors to be Considered

The ideal way to convert a data processing system (or sub-system) is to establish a conversion date which is accepted by all users who might be affected. All data in computer files must be processable in SI units on the announced date, and SI unit versions of all the relevant software and procedures must be tested and in place by that date. Starting on the announced conversion date, all input data must be supplied in SI units, the internal calculations are all performed using SI units, and the output reports must exhibit SI units. If and when the historical data have been converted to SI units, the original data should be kept only as long as they are deemed necessary for data security and in accordance with company policy.

Some of the expense and disruptions associated with the SI conversion of a system may be avoided if the conversion can be done at the same time as other modifications are being applied to the system.

New systems under development should be designed so that all internal calculations are in SI units, even if input and/or output data must temporarily be expressed in non-SI units. This approach should minimize the long-term conversion costs (although it may increase the short-term operating costs).

In summary, the planners must consider the questions of whether conversion of each system should be partial or complete, and whether the conversion can best be performed all at once or in stages. Important factors which may influence these choices include:

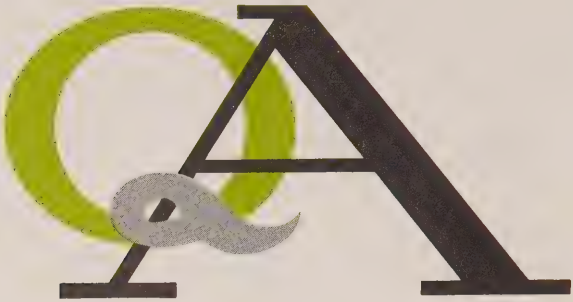
— the number of applications involved
— the complexity of the applications
— the criticality of the applications
— the life expectancy of the programs
— the life expectancy of historical data
— the expected lifespan of dual capability processing
— the number of data files or data bases involved
— the volume of data in each file or data base
— the frequency of use of the data
— the ease of modification of the programs
— the ease of conversion of the data
— the flexibility permitted in scheduling

Implementation

Once the decision has been made to convert, the system requiring conversion identified and the conversion plan established, the next task is to proceed with the actual implementation. Remember, the conversion to metric is not difficult. The problems encountered have been identified, in most cases, to be the result of poor planning or non-compliance with the companies' established conversion plan.

The person responsible for the metric conversion project within the company should monitor the conversion and report its progress to management. The tasks involved in the conversion will have been established as a result of the plan. (See — 'Typical Conversion Tasks'.) Monitoring, reporting and controlling the metric conversion in accordance with the established plan are key elements in ensuring an efficient, effective, and non-disruptive metric conversion.

As with all data processing systems, all programs should be subjected to the usual testing procedures of the installation. In some cases, this will involve program testing, computer system testing and user testing, depending on the complexity of the application systems.



1. **Q. To whom does metric apply?**

   A. The transition to metric measurement in Canada will change virtually every measurement unit now in use. All DP systems that handle measurement — sensitive or numerical data will be affected to some degree. Since the conversion to metric is being phased over several years, some EDP systems will be expected to handle both imperial and metric units at the same time.

2. **Q. Is the conversion to metric compulsory?**

   A. Metric conversion is primarily voluntary. However, the Statute Law (Metric Conversion) Amendment Act, 1976, altered references in a number of federal Acts to metric terms.

   Furthermore, dates have been established by law for the use of metric only in the following areas:

   Sector 2.04 — Speedometers and odometers
   3.08 — Agricultural chemicals, fertilizers
   3.10 — Retail food scales
   4.03 — Retailing of gasoline
   5.06 — Road Speed and distance signs
   61.02 — Feed Industry
   62.04 — Dairy Processors
   62.05 — Specific sizes for certain products
   63.04 — Wine
   9.50 — Home furnishings

   The White Paper on Metric Conversion in Canada "1970" states that "This single system should come to be used for all measurement purposes required under legislation, and generally be accepted for all measurement purposes."

3. Q. **What Acts have been revised by the Statute Law (Metric Conversion) Amendment Act, 1976?**

   A. The following list indicates the Acts amended by the Statute Law (Metric Conversion) Amendment Act, 1976:

   Canadian Wheat Board Act
   Consumer Packaging and Labelling Act
   Gas Inspection Act
   Oil and Gas Production and Conservation Act
   Prairie Grain Advance Payments Act
   Two-Price Wheat Act
   Weights and Measures Act
   Western Grain Stabilization Act

4. Q. **What will be the impact on the user of the conversion of data processing equipment to metric sizes?**

   A. Metric conversion of data processing equipment will be completely transparent to users. A good analogy is an automobile that has been designed and built with metric parts with no impact on its operation to the driver.

5. Q. **What will the size of a metric card be? What about magnetic tapes?**

   A. There is no reason to change these because of metric conversion. For example, the standard magnetic tape and the punched card, as it is known today, may be expressed directly in metric terms.

6. Q. **International metric paper sizes are different. Will printers and automatic carriages be changed to accommodate these sizes?**

   A. The question of paper size and metric conversion should not be confused Metric conversion does not include changing paper sizes. The International Organization for Standardization (ISO) paper sizes have been in use in Europe for quite some time. The Canadian General Standards Board (CGSB) has developed standards on correspondence (CAN2-9.60M-76) and printing (CAN2-9.61M-76) paper sizes which have been approved as National Standards of Canada by the Standards Council of Canada. These standards reaffirm the current practice on paper sizes in Canada. CGSB is also working on a standard for Continuous Business Forms.

7. Q. **What about character and line spacing?**

   A. Character and line spacings are already an existing international standard. There is a proposal currently being considered by ISO, which expresses such spacing in metric units, such as 6 lines per 25.4 mm. etc. Therefore, no changes are expected in character and line spacing because of metric conversion.

8. Q. **Will metric conversion force me to redesign my forms?**

A. No changes are expected in character size and line spacing, however, data field size changes might necessitate forms redesign (see Question No. 14).

9. Q. How can I use lower case characters for metric symbols on my 'upper case only' printer? Will special symbols be provided?

A. There is no problem with lower or upper case to print metric symbols when the standard, the *Canadian Metric Practice Guide*, is followed. Although it is desirable that metric symbols be printed using both upper and lower case, the standard provides for limited character sets.

National Standards of Canada Publication CAN3-Z234.1-79, '*Canadian Metric Practice Guide*', Appendix C titled 'Information Processing — Representation of SI and Other Units for Use Only in Systems with Limited Character Sets', contains all the information required on what symbols to use with systems having limited character sets. This standard can be obtained from the Canadian Standards Association.

For example:

Name Of Unit	International Symbol	Representation		
		Form I	Form II	
		Double Case	Single Case Lower	Single Case Upper
metre	m	m	m	M
millimetre	mm	mm	mm	MM
gram	g	g	g	G
kilogram	kg	kg	kg	KG
degree Celsius	°C	Cel	cel	CEL

(Source — *Canadian Metric Practice Guide* — CAN3-Z234.1-79)

For those people who might use the computer printout for publication in a text, the printed symbols should be printed in accordance with the *Canadian Metric Practice Guide*. See Appendix C, C1.3.

10. Q. What are the rules for writing numbers?

A. The Canadian Metric Practice Guide, Section 2.7, gives the following specific rules on how numbers should be displayed:

The decimal marker is independent of any language or system of units. Both the point and the comma are widely used throughout the world as the decimal marker. In Canada, *the recommended* decimal marker is the point,

although the comma may be used. Only one type of marker shall be used throughout a text. The decimal marker shall be positioned in line with the base of the associated numerals.

The triad separator, formerly the comma, used to facilitate reading long numbers, shall be a space, unless there is a reason for it to be otherwise, but in no case shall a point or a comma be used. This separator (space) will be used to form groups of numbers in threes, both to the left and right of the decimal marker.
Examples:
32 453.246 072 5
1245 (1 245 optional)
3.1416 (3.141 6 optional) but 3.141 59

At the CSA Committee on Metric Practice Guide meeting of August 27, 1980, it was agreed to add the following with regard to the clause on the triad separator to the Canadian Metric Practice Guide:

> This clause need not apply to monetary values and shall not be used on payment instruments.

Note: Monetary symbols are not SI symbols; however, such symbols in compound form with SI symbols for other units may be treated as unit symbols.
(e.g. "3.50 $/kg")

If a number is less than one, a zero should precede the decimal marker. (e.g. 0.5)

A dot shall not be used as the multiplication symbol in conjunction with numerals.
Example:
234 × 126.7, not 234•126.7

(Source — *Canadian Metric Practice Guide* — CAN3-Z234.1-79)

11. Q. Any problems in data input using the above rules?

A. Many are encountering input problems arising from the new system of expressing numbers (see question 10 above). The input operator accustomed to seeing commas and not blanks as triad separators could inadvertently originate errors.

It should be noted that some computer software, such as compilers, may not allow spaces in a single number field. Similarly, many compilers and application programs accept the comma as a field delimiter and never as a decimal marker. (See question 12 below).

12. Q. Will there be difficulties in displaying numbers?

A. *COBOL-PL/1*

COBOL and PL/1 are able to display the new format with little difficulty, but programs may have to be re-compiled should changes be required in order to meet other metric requirements.

The major difficulty will be with existing purchased software which outputs printed material. Some form of postprocessor may have to be written or

modifications made, in-house or by the vendor, to accommodate metric conversion.

FORTRAN

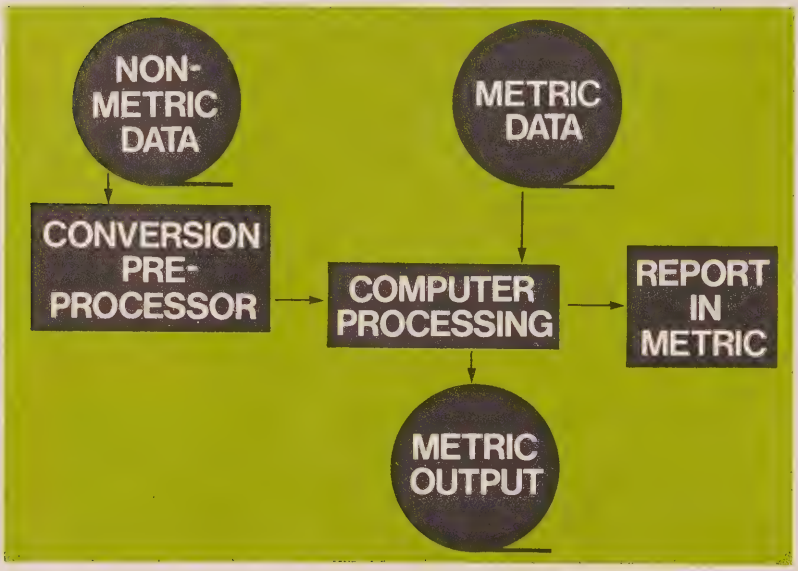
No particular problems should be encountered from the point of view of performing metric calculations. The greatest difficulty would appear to be in representing data values in the metric convention.

For example, the statement A=1234.5 could be shown as A = 1 234.5 and would be correct because FORTRAN ignores all blanks, including those imbedded within constants.

However, the form A=1 234,5 using the comma as the decimal marker, would not be acceptable because FORTRAN uses the comma as a separator in a list of items. There is no easy way to represent data values in this form on input or output. To display or read the data would require a conversion subroutine to be executed.

13. Q. **What do the terms preprocessor and postprocessor mean? Where could they be used?**

A. This is a technique used by many organizations and departments when requirements change to accommodate using existing programs. Suppose an operational program handles all of its calculations in imperial but input to this program may be either in imperial or metric terms. A preprocessor, which could be a single computer program statement, might convert all metric terms so that they can be operated on by the main program. In complex situations, a preprocessor run may be necessary.



The postprocessor is at the output end, to ensure a consistent expression of units of measurement.

In some cases, the use of preprocessors and postprocessors may be considered in the planning stages, either through choice or necessity. Two factors to consider in the planning of data processing conversion are as follows:

(a) Non-conversion of Program Internals

It may be possible to reduce (or defer) the conversion costs of some programs by leaving the internal calculations in original units and adding data conversion modules. A 'preprocessor' module can be developed to convert data from SI units to non-SI units as required by the program. Similarly, a 'postprocessor' module can be developed to convert the results back to SI units for display and reporting.

If this approach is adopted, the long-term operating costs of the programs will increase because of the additional data manipulations required in the input and output operations. In time, maintenance of the software will become increasingly difficult as programmers and users become less knowledgeable in the non-SI units.

If data must be converted from SI units to non-SI units on input and from non-SI units to SI units on output, inaccuracies will be introduced because of compounded round-off effects. For this reason, the double conversion process is usually not recommended.

(b) Handling of Non-SI Input Data

When the SI version of a system has been developed and implemented, it may not be possible to convert all of the data sources so that they will immediately begin providing input data in SI units.

In such cases, a preprocessor module can be developed and used temporarily to convert input data from non-SI units to SI units. During the switchover period, the software may have to deal with a mixture of non-SI data and SI data, which implies that there must be a facility to recognize which data items are non-SI and which are SI, so that the conversion will be performed only when it is appropriate. This approach will involve some additional development costs and short-term processing costs. On the other hand, it could be very expensive to attempt to convert all of the sources of data simultaneously.

14. Q. What is the impact of metric conversion on the size of data fields?

A. Any application that is measurement-sensitive, that is, containing dimensions such as lengths, volumes, quantities, weights, etc., will have to be carefully reviewed by the users to determine if the field size, when converting from inches to centimetres, pounds to kilograms, etc., must be changed or not. Because of the difference in magnitude of the quantities represented by a metric unit and its corresponding imperial unit, metric conversion may necessitate a change (increase or decrease) in the number of significant digits required for a given data item. For example,

we can represent a volume of liquid in the range of 0 to 99 gallons using 2 digits; for the equivalent range in metric units of liquid volume (0-450 L (litres)) we require a field of 3 digits. The question of different field sizes would still have to be addressed for each application and form design.

15. Q. Are there conversion tables, and what are commonly encountered problems here?

A. Conversion tables abound. A good source is the *Canadian Metric Practice Guide* (CAN3-Z234.1-79). However, the actual factors which are used should be verified by the end-user.

The things that a system analyst might consider:

(i) Does the analyst have to consider both measurement systems? Many cars, for example, still have odometer readings expressed in miles, so for a 'mileage' claim, should the traveller be expected to convert, should there be parallel streams, should the computer do the conversion? Control checks should be embedded in both the computer program and the supporting procedures to ensure that the correct rates and units of measurements are applied.

(ii) Precision and accuracy requirements should be studied by the analyst. Again using the traveller's claim example, one test might be that regardless of whether the claim is submitted in miles or kilometres, the traveller recovers the same amount of dollars. An example follows:

Assume a scenario where the traveller is entitled to claim $0.25/mile or $0.155/km. He wants to be paid for 75 miles of automobile use.

Using mileage rates, he is entitled to 75 x $0.25 = $18.75. Converting to metric, the distance travelled is 75 x 1.609 = 121 km. When using metric rates, he is entitled to 121 km x $0.155/km = $18.75. The traveller would receive the same amount.

The procedure instituted by some companies is to have the distance claimed in either system of measurement, then convert to the system in which the rate is expressed before calculating entitlements.

16. Q. What is the impact on unit conversion calculations?

A. Stepping up and down the non-SI scale may require modifications to the computational logic or to numeric constants, for example, 16 ounces to the pound. One big advantage of the metric system is that measurement changes are always in powers of ten.

Consult the *Canadian Metric Practice Guide* (CAN3-Z234.1-79) section 7 for conversion factors which give the relationship between SI units and the old Canadian legal units.

17. Q. Will historical data have to be converted?

A. Regardless of when a system is converted to metric, there will almost certainly be occasions to process historical data which is not recorded in metric units. Historical data may be treated in a variety of ways. Data may be converted to metric, either immediately or as required. New metric data may be converted to non-metric units for historical comparisons, provided that there is no long-range impact in the conversion to metric; or data may be stored using both methods. The latter two would be detrimental to a fast, meaningful conversion and encourages the continued use of non-metric.

If historical data are maintained in computer files or data bases in non-SI units, while current and future data are to be stored in SI units, several potential sources of difficulty must be considered. Computer routines must be provided with a means of identifying those data items which are stored in non-SI units and must be able to deal with them correctly. Anyone accessing the data must know how to recognize which data are non-SI and which are SI.

It is important that all occurences of a given class of data within a single file or database should be converted at the same time. A piecemeal conversion, in which some occurences are changed to SI units, and others are left in non-SI units for the time being, would involve extra overheads in conversion and processing costs, and would introduce potential sources of error or misunderstanding.

In the case of some historical data, it may be argued that the costs of conversion cannot be justified because there is very little likelihood that the data will ever be used again. In such cases, serious consideration should be given to the question of whether the information is worth keeping at all.

18. Q. Is there any educational material available?

A. General material published by Metric Commission Canada is available, for example, *Introduction to the Metric System*. This booklet was originally compiled and published by the Manitoba Department of Education and has been reprinted by Metric Commission Canada.

Another excellent Metric Commission Canada publication is one entitled *How to write SI*. Additionally, an organization's Metric Conversion Coordinator will have a Metric Conversion Plan and a list of relevant educational material.

The national standard, referred to earlier, the *Canadian Metric Practice Guide*, is mandatory reading for anyone with 'metric' responsibility. See bibliography below.

Computer aided instruction can be used and possibly some programs may be developed by users. At this time, however, their availability and portability cannot be assessed.

19. Q. Is there any source of information on the subject of metric conversion?

A. Metric Commission Canada, Box 4000, Ottawa, K1S 5G8, has a large quantity of general pamphlets, booklets and publications available to inform the public on the progress of metric conversion in Canada.

In addition, it has divided the Canadian economy into 12 broad areas, each having several sector committees responsible for the investigation, planning, scheduling and monitoring of metric conversion in its particular sector. Sector Committee 9.30 deals with Services to Business Management and includes representatives from the data processing application area. Sector Committee 3.04 deals with the development and manufacturing of DP equipment. These committees may be contacted through the National Associations or Metric Commission Canada.

20. Q. Is there any service available to vet documents for correct metric usage?

A. To assist in assuring correct metric usage, the Canadian General Standards Board (CGSB) has established a metric screening service which is available to all organizations on a fee basis. The purpose of this service is to screen proposed publications, documents and other items in order to ensure that the metric usage is in accordance with the national standard, the *Canadian Metric Practice Guide*.

Further information is available from:

Metric Screening Office
Canadian General Standards Board
11 Laurier Street
Hull, Québec, K1A 0S5

Bibliography

Standards Publications:

1) CAN3-Z234.2-76 (CSA)
The International System of Units (SI)

2) CAN3-Z234.1-79 (CSA)
The Canadian Metric Practice Guide

3) CAN2-9.60M-76 (CGSB)
Standards on Correspondence Paper sizes

4) CAN2-9.61M-76 (CGSB)
Standards on Printing Paper Sizes

Articles and Papers on Metric Conversion in Data Processing:

1) 'Planned Metrication of Computer Systems in a Large Steelworks'
W. Hanlon & G.A. Hamer
Australian Computer Journal, Vol. 6, No. 2, July 1974.

2) 'Planning for Metric Measurement in System Design'
J.L. Pokorney
Innovative Management Systems, Inc.
Northbrook, Illinois, June 1973.

3) 'Metric Conversion and its Effect on Data Processing'
G.R. Comrie
CIPS Review, October 1977, December 1977,
February 1978, Vol. 2, NOS 1-3.

4) "A Technical Report on Metric Conversion & the Computer" L. R. Long, Secretariat, Government EDP Standards Committee, K1A 0S5, Ottawa, Supply and Services Canada, June 1979.

Planning Publications:

1) How to Launch Metric Conversion In Your Organization
1 — Investigation Phase, 1974, Metric Commission Canada.

2) How to Plan Metric Conversion
2 — The Planning Phase, 1979, Metric Commission Canada.

Standards Publications are available from:

Canadian Standards Association (CSA)
178 Rexdale Boulevard
Rexdale, Ontario, Canada
M9W 1R3

Canadian General Standards Board (CGSB)
11 Laurier Street
Hull, Québec
K1A 0S5

Metric Commission Canada publications are available from:

Metric Commission Canada
Box 4000
Ottawa, Ontario
K1S 5G8

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